DIA4N

DIGITAL PROTECTION RELAY
FOR MV ENERGY PRODUCTORS

USER MANUAL

P514D832 June 2014
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1 GENERAL CHARACTERISTICS

The protection relay DIA4N performs functions such as interface relay for MV energy producers, according to Italian norm CEI 0-16 ed. 3 issued on December 2012.

The protection relay DIA4N is also useful as a generic voltage and/or frequency relay in different contexts from those foreseen by norm CEI 0-16.

The functions shown in the following table are available.

<table>
<thead>
<tr>
<th>Function</th>
<th>ANSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undervoltage</td>
<td>27</td>
</tr>
<tr>
<td>Overvoltage</td>
<td>59</td>
</tr>
<tr>
<td>Residual overvoltage</td>
<td>59N / 59Vo</td>
</tr>
<tr>
<td>Under frequency</td>
<td>81&lt;</td>
</tr>
<tr>
<td>Over frequency</td>
<td>81&gt;</td>
</tr>
<tr>
<td>Frequency thresholds with voltmetric control</td>
<td>81V</td>
</tr>
<tr>
<td>Positive sequence undervoltage</td>
<td>27V1</td>
</tr>
<tr>
<td>Negative sequence overvoltage</td>
<td>59V2</td>
</tr>
<tr>
<td>Breaker failure</td>
<td></td>
</tr>
<tr>
<td>Remote trip</td>
<td></td>
</tr>
</tbody>
</table>

All the setup and measured parameters can be viewed on the front panel display and transmitted on the RS485 communication serial port.

THRESHOLD – the following thresholds are available:

- 2 three phase undervoltage thresholds 27.1 - 27.2
- 2 three phase overvoltage thresholds 59.1 - 59.2
- 1 residual overvoltage threshold 59N.1
- 2 over frequency thresholds 81> - 81>>
- 2 under frequency thresholds 81< - 81<<
- 1 positive sequence undervoltage threshold 27V1
- 1 negative sequence overvoltage threshold 59V2

The available settings for each threshold are listed in Table A.

The protection functions related to frequency measurement are disabled (trip condition and relay activation) in the following conditions:

- Measured voltage lower than 0.2 Un
Thresholds 27V1 and 59V2 are used only to perform the 81V function, therefore they are not equipped with all the features usually available for the other thresholds (for example, they do not have the counters of shots).

**TRIP DELAYS** - a programmable time delay (TI) is available for each threshold; it can be programmed by the user.

In certain thresholds / functions, which will be specified later, there is a release timer (TR time), whose value can be set by the user.

The available settings for each timers are listed in Table A.

**OUTPUT RELAYS** - the DIA4N controls 4 output relays (named R1, R2, R3 and R4); these relays can be programmed to be activated on START or TRIP conditions of one or more thresholds.

<table>
<thead>
<tr>
<th>START</th>
<th>instantaneous activation of the output relay when at least one of the measured voltages exceeds the programmed threshold value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIP</td>
<td>activation of the output relay when the programmed time delay (TI) related to a threshold expires.</td>
</tr>
</tbody>
</table>

The quiescent state of each single relay R1, R2, R3 and R4 can be programmed as normally energized (ON) or normally de-energized (OFF).

An additional relay R5 (normally energized) is controlled by the self-diagnosis routines to report detected fault conditions.

Related to each threshold, partial and total counters of TRIP conditions are available.

**DIGITAL INPUTS** - there are available 3 digital inputs to activate the following functions (when enabled by the programmed set-up):

- on/off thresholds (related to one or more thresholds)
- STATUS function (recording of measures on external event)
- pilot wire fault monitoring (only for DIG2)
- Local Command function
- Circuit breaker status (open / close) for BF function
- Remote trip

For each digital input can be programmed the condition that activates the related functions:

- HI voltage = > 20 V dc / ac
- LO voltage = 0 ÷ 10 V dc / ac
The digital input acquisition is valid when the voltage value stays in the range HI or LO for at least 30 ms.

**DISPLAY OF MEASURES** - the user can select the continuous display of a measured voltage (primary values) or the frequency (in Hz); all the measures can be transmitted to an external controller through the RS485 port.

**EVENTS** - information related to the last 8 events (POWER ON, TRIP or STATUS) are recorded in the EEPROM memory.

Information includes the threshold set-up and activated relays (TRIP event only), the measured voltages, the digital input status, date and time of the event.

**SELF-DIAGNOSIS** - the software includes a non stop monitoring module that controls the functionality of all hardware and software resources of the protection relay.

Detected fault conditions are reported by:

- diagnostic message on the display
- glow of a red LED on front panel
- R5 output relay drop-off

The fault condition signaling stays until faults are pointed out by the monitoring module; during this condition the protection functions are suspended to avoid unsuitable tripping.

**STATUS FUNCTION** - when the STATUS function is activated by one of the digital input (when programmed) the protection relay memorizes information related to measured voltages and digital input status (see par. 5.10 - EVENTS). The recorded information allows an analysis of trip causes in co-operative protection relays systems.

**PILOT WIRE FAULT MONITORING** - when the function is programmed, the digital input DIG2 is used to control the correct functionality of the pilot wire. Digital input DIG2 is always expected to be complementary of DIG1 input (HI-LO or LO-HI) to identify faults on pilot wire.

The fault condition is reported as detected by the self-diagnosis module but the protection functions are not suspended; only the functions related to DIG1 digital input are suspended as the DIG1 status cannot be longer considered as true.

The fault condition is reported when DIG1 and DIG2 signals are not complementary for more than 100 ms.

**REMOTE COMMUNICATION** - the opto-insulated serial port RS485 can communicate with a personal computer or a remote control and monitoring system equipped with an RS485 interface or with a standard RS485/RS232 converter.

It is possible to select the communication standard between STANDARD (ASCII 7 bit - Seb protocol) or MODBUS (ASCII mode, SLAVE).
All the set-up and measured parameters can be transmitted on the RS485 communication serial port; when communication is active (LED REMOTE glows), the operator on front panel can view the relay set-up but changes of parameters are disabled (ENTER and buttons disabled).

1.1 Undervoltage thresholds (ANSI 27)

Two three phase undervoltage are available (27.1, 27.2). Both thresholds may be enabled or disabled by the user, in independent mode between them. When one or more of the measured phase voltages drops under the threshold value, the threshold trips.

The available settings for the thresholds are listed in Table A.

1.2 Overvoltage thresholds (ANSI 59)

Two three phase overvoltage are available (59.1, 59.2). Both thresholds may be enabled or disabled by the user, in independent mode between them. When one or more of the measured phase voltages exceed the threshold value, the threshold trips.

The threshold 59.1 uses a 10 minutes mean value of the voltages, according to Annex S of the norm CEI 0-16. The measured value is updated every 3 seconds.

The available settings for the thresholds are listed in Table A.

1.3 Residual overvoltage threshold (ANSI 59N)

One residual overvoltage threshold is available (59N.1). The threshold may be enabled or disabled by the user.

This threshold has a timer on start condition falloff (TR 59N.1), which is useful to avoid continuous activation and falloff of the start 59N.1 signal in the case of intermittent fault or at the extinction of the fault, due to saturation of the inductive ferromagnetic VT connected between phase and neutral. The recommended value for this timer is 200 ms.

The available settings for the thresholds are listed in Table A.

1.4 Under frequency thresholds (ANSI 81)

Two under frequency thresholds are available (81<, 81<<). Both thresholds may be enabled or disabled by the user, in independent mode between them.¹

¹ If you use the 81V function (as required by the norm CEI 0-16 ed. 3), both the thresholds 81< and 81<< have to be enabled.
The under frequency threshold, with the related over frequency thresholds, are specially suitable for the following applications:

- control of the frequency
- graded load-shedding in overloaded systems due to loss of generating units or mains failure

The available settings for the thresholds are listed in Table A.

1.5 Over frequency thresholds (ANSI 81)

Two over frequency thresholds are available (81>, 81>>)

Both thresholds may be enabled or disabled by the user, in independent mode between them.2

The available settings for the thresholds are listed in Table A.

1.6 Frequency thresholds with voltmetric control (ANSI 81V)

This function is required by norm CEI 0-16 ed. 3, therefore should be enabled if the protection relay is used in systems that must meet the requirements of this rule.

This function may be enabled or disabled by the user.

For proper operation of this function it is necessary that both two under frequency threshold (81< and 81<<) and two over frequency threshold (81> and 81>>) are enabled.

For its operation, in addition to the logic signals for start and trip from 59N1 threshold, this function uses a negative sequence overvoltage threshold (59V2) and a positive sequence undervoltage threshold (27V1). Both the values of these two thresholds are programmable by the user (see Table A). These thresholds are equipped with the related timer, whose value is programmable by the user and should be used if you wish to use the logic trip signal (TRIP) in place of the start signal (START) to enable the thresholds 81> and 81<; thresholds 81>> and 81<< are always enabled.

If you enable this function, you have to set a digital input to acquire the status of the Local Command signal. When the Local Command signal has logical status HIGH, the protection relay operates always with restrictive frequency thresholds (81> and 81<) active; when the Local Command has logical status LOW, the restrictive frequency thresholds (81> and 81<) activation is related to the thresholds 27V1, 59V2 and 59N1 exceeding.

If it is enabled, this function acts on the restrictive frequency thresholds (81> and 81<), enabled only when one or more of the following conditions occur:

- threshold 27V1 exceeding
- threshold 59V2 exceeding
- threshold 59N1 exceeding
- logical status of Local Command signal is HIGH

2 If you use the 81V function (as required by the norm CEI 0-16 ed. 3), both the thresholds 81> and 81>> have to be enabled.
The mode in which the thresholds 27V1, 59V2 and 59N1 determine the enabling of the thresholds 81> and 81< can be selected by the user according to three different modes:

- **OFF**  Threshold not used in function 81V
- **START**  The threshold exceeding condition is the start one
- **TRIP**  The threshold exceeding condition is the trip one

The operating logic of the frequency threshold with voltmetric control is shown in the following diagram.

Legend:
- **Freq.**  Frequency measurement
- **U1**  Positive sequence voltage (calculated by relay)
- **U2**  Negative sequence voltage (calculated by relay)
- **Uo**  Earth fault voltage (measured by relay)
- **DI**  Digital input (set as Local Command)
- **AVV 81V**  “Start 81V”\(^4\) signaling
- **TRIP 81>**  Trip threshold 81>
- **TRIP 81<**  Trip threshold 81<

Please note the presence of a release timer (TR 81V), useful to not vary continuously the enabling of thresholds 81< and 81> during the reclosing cycles. The suggested setting value for that timer is 30 s.

When you use the function 81V, the delay timers for thresholds 81> and 81< (TI 81> and TI81<) should have the same value.

---

\(^3\) This is the setting required by norm CEI 0-16 ed. 3

\(^4\) This signal can be carried outside by configuring one of the available relays, to communicate to the external generators the operating condition with frequency thresholds restricted enabled.
During the setup procedure, the protection relay does a check on setup parameters, and it shows an error message when one or more of the following cases occur:

- no digital input programmed to acquire the Local Command signal
- one or more frequency thresholds are disabled (OFF)
- the setup values of restrictive frequency thresholds \( (81< \text{ and } 81>) \) are more distant from the nominal value than the permissive frequency thresholds \( (81<< \text{ and } 81>>) \)
- one or more frequency thresholds could be disabled by digital inputs

In case you don't enable the 81V function, the frequency thresholds don't have special constraints except those related to their enabling settings, according to the user preferences.

### 1.7 Breaker Failure function (MAI function)

This function uses a digital input to get the "circuit breaker open" status or the "circuit breaker close" status.

When a circuit breaker opening command is issued as a result of the protection functions, it is expected that the signal "circuit breaker closed" to disappear within a preset time, or that the signal "circuit breaker open" appears within a preset time, indicating that the circuit breaker has been successfully opened. If this does not happen, or at the expiration of the time provided for the circuit breaker is still in the closed condition, another command is issued to open another circuit breaker.

This function could be enabled or disabled by the user.

The available settings for the timer related to this function are listed in Table A.

### 1.8 Remote Trip function

This function uses a digital input, properly programmed to acquire the "Remote Trip" signal (TRIP EXT) and, after a programmable delay (TI EXT), it issues a command to open the circuit breaker.

The function is automatically enabled when a digital input is programmed with the TRIP EXT function.
2 FRONT PANEL KEYS

The 5 push-buttons on the front panel allow to visualize all the protection parameters and to modify the protection set-up.

- right arrow
- down arrow
- ENTER: programming session activation or parameter confirmation
- change or increment of the selected parameter
- RESET: reset of the protection relay (rif. par. 4.3)

VISUALIZATION OF PARAMETERS

- all visualizations are circular and they can be displayed using the two arrow push-buttons.
- the structure of the visualizations and their contents are showed in Figures 1, 2 and 3.
- when the sealable transparent front panel is installed only the arrow push-buttons and the RESET push-button are accessible to prevent unauthorized modification of the protection set-up.

MODIFICATION OF PARAMETERS

- remove the transparent sealable front panel to access ENTER and push-buttons.
3 FRONT PANEL LED SIGNALLINGS

POWER (green) ⊕ auxiliary supply available

FAIL (red) ⊕ fault condition detected by SELF-DIAGNOSIS software or by PILOT WIRE FAULT MONITORING function.

REMOTE (red) ⊕ communication session active on RS485 port

27 - 59 (red) ⊕ trip condition on 27.1, 27.2, 59.1 or 59.2 thresholds

59N (red) ⊕ trip condition on 59N.1 threshold

81 (red) ⊕ trip condition on 81>, 81>>, 81< or 81<< thresholds

The last trip condition (threshold indication) is also showed on front panel display; more information on trip condition are presented in the recorded EVENT (see par. 5.10).
4 PROGRAMMING AND TEST

The protection relay is easily programmable following the instructions in the next paragraphs:

- HOW TO PROGRAM THE PROTECTION RELAY
- HOW TO MODIFY A VISUALIZED PARAMETER

All parameters can be freely modified; the proper protection set-up as required by the plant management is submitted to the operator's judgment.

4.1 How to program the protection relay

The programmable parameters are showed in Figures 1, 2, 3 and 4 at the following references:

- B2÷B7 relay address (RS485) and date/time
- D1÷D6 nominal values, contrast etc.
- E1÷E4 setup values and time delays for 27 and 59 thresholds
- E1N÷E5N setup values and time delays for 59N threshold
- E1F+E3F setup values and time delays for 81 thresholds
- E1V+E10V setup values and time delays for 81V function
- E1M+E3M setup values and time delays for MAI function
- F1÷F15 output relays functions
- G1÷G3 digital input functions
- H1÷H2 special functions
- R1÷R22 partial trip counters reset

The programming sequence is the following:

1) SELECT the visualization (on display) of the parameter to be modified using the arrow push-buttons

2) ACTIVATE the PARAMETER MODIFICATION session depressing the [ENTER] push-button and modify the parameter value

3) END the parameter modification session depressing again the [ENTER] push-button

4) REPEAT the procedure from 1) to 3) for all the parameters required to obtain the new protection relay set-up

5) CONFIRM the new protection relay set-up at the visualization CONFIRM PROG? (Fig. 3, ref. J1) within 5 minutes depressing the push-buttons buttons [ENTER], up to visualize YES and [ENTER] again to confirm.

NOTE: The protection relay continues to operate using the previous set-up until the new set-up is confirmed as at point 5) above; the visualization of the modified parameters before the new set-up confirmation is only temporary to allow an easy definition of the new protection set-up.
If the new set-up is not confirmed within 5 minutes from the last pressed push-button, the protection relay visualizes again the previous set-up (the parameters set-up that the protection relay is still using).

4.2 How to modify a visualized parameter
When the parameter to be modified is visualized on front panel display do the following sequence:

1) PRESS [ENTER] to activate the parameter modification session
If one or more parameters are modifiable, on the first of them will appear a blinking cursor.
If no parameters are modifiable, no blinking cursor will appear.

2) MODIFY THE PARAMETER pressing the arrow push-buttons and when two parameters are modifiable, the push-button allows to point-out the parameter to be modified (the selected parameter will blink)
   when numerical parameters are pointed-out the push-button allows to select the digit to be modified
   increasing of the parameter
   a) the digits are increased by 1 unit
   b) the other parameters are presented following the selection list

3) PRESS [ENTER] to end parameter modification session
The modification session is ended and the parameter stops to blink
NOTE: if a numerical parameter is selected out of the accepted range (as shown in Table A) when the push-button [ENTER] is pressed for few seconds an error message will be displayed as:

| Data | Error |

and the parameter will be displayed again with the former value.

4.3 Reset
When the push-button [RESET] is pressed, the protection relays returns to the standard condition:

- reset of glowing LEDs
• drop-off of tripped relays
• reset of any parameter changed but not confirmed (parameters are shown as confirmed at the end of the last programming session)
• display on STANDARD MODE (Fig. 1, ref. A1 - par. 5.1)

4.4 Test of output relays

When the output relays test is selected (Fig. 2, ref. F8) it is possible to command an output relay (one at the time) to trip from the current status allowing functional tests on electrical plants.

The output relays are activated with the following sequence:

1) SELECT THE VISUALIZATION of the desired output relay to be tested

2) PRESS [ENTER] to activate the test session; the message OFF will start to blink.

3) PRESS ; and the message on the display will change as:

4) PRESS [ENTER] to command the instantaneous trip of the output relay (change of the current status).

The relay will stay on the new condition until:

• the or [RESET] push-button is pressed
• the [ENTER] push-button is pressed and the sequence at points 3 and 4 is repeated (presenting OFF condition)

The same procedure will be used for R2, R3 and R4 relays.
5  DISPLAY AND PROGRAMMING

The contents and the structure of the displayed messages are shown in figures 1, 2, 3 and 4; the references A1, B1, B2 etc. identify specific displayed messages in the figures.

5.1  Standard display

A1 - STANDARD DISPLAY

It is the standard displayed message without operator's intervention (no push-buttons pressed for at least 5 minutes) or when the RESET push-button has been pressed.

The displayed information is function of the protection relay status.

NORMAL FUNCTIONING

During this state the following information can be visualized (as defined by set-up):

Protection function (ANSI code) - the display shows the ANSI codes of the active functions.

Measured values - the display shows one of the measured voltages or the frequency; the values to be visualized is selected by operator (ref. D5).

The voltages are visualized as primary value, in Volt, the frequency is visualized in Hz.

ON TRIP CONDITION

When a trip condition occurs the protection relay visualizes the TRIP message that includes the threshold related to the trip; the displayed messages are as the following:

| TRIP 27.1 | TRIP 59.1 | TRIP 81< | TRIP 81> |

The information of the trip, as well the glowing of the related LEDs, is displayed until the [RESET] push-button is pressed.

If a new trip condition occurs, the displayed information will be updated; information related to previous trips are recorded in EVENTS memory.

FAULT CONDITION

When a permanent or temporary fault condition is detected by the self-diagnosis module, the following message is displayed:

FAIL

eeeeeeee

The string eeeeeeee can be:

F.PILOTA Detected fault condition on pilot wire; the function related to DIG1 digital input is suspended

Corrective action - verify pilot wire (short or open circuit)
HARDWARE | Detected fault condition on hardware or software resources of the protection relay; all functions are suspended. Corrective action - replace the protection relay and contact SEB post sales service

5.2 Visualization structure

Figure 1
5.3 Address and Time (fig. 1)

B1 - RELAY MODEL (not programmable)

DIA4N
mod. T4

B2 - COMMUNICATION PROTOCOL (programmable)

The communication protocol is programmable between the followings:

STANDARD: ASCII SEB protocol
MODBUS: Modbus ASCII protocol (SLAVE)

When the MODBUS protocol is selected the following display is showed to allow the selection of the transmission speed:

BAUDRATE

The xxxx parameter is selectable between the followings:

300 - 600 - 1200 - 2400 - 4800 - 9600

When the STANDARD protocol is selected the baud rate is automatically selected by the protection relay.

B4 - ADDRESS (programmable)

NR RELAY
001

Programmable address from 001 to 255.

The number is used on RS485 port to address a specific relay when two or more protection relays are linked on the same serial line.

B5 - RELAY SERIAL NUMBER (not programmable)

SER. NR
0012345

B6 - FIRMWARE VERSION (not programmable)

VERS. FW
zz.zz
B7 - TIME/DATE (programmable)

**dd/mm/yy**

**hh:mm:ss**

Time and date are programmable and they are used to mark recorded events.

The clock circuit is equipped with a supercapacitor, which ensures the proper functioning of the clock for 1 week even in the absence of auxiliary voltage. In case the supercapacitor run out of its charge, the clock is reset to date:

01/01/10
00:00:00

5.4 Nominal values set-up (fig. 2)

D1 - NOMINAL LINE VOLTAGE SELECTION - Un (programmable)

Un = xxx.xx V

Un: nominal line voltage selection (nominal secondary voltage of plant VTs) selectable between the followings:

57.73 - 63.50 - 72.16 - 100 - 110 - 125 - 190 - 230 - 380 - 400
200 - 202 - 208 - 240 - 270 - 277 - 300 - 315 - 320

D2 - NOMINAL RESIDUAL VOLTAGE SELECTION - Uon (programmable)

Uon = xxx.xx V

Uon: nominal residual voltage selection (nominal secondary voltage of plant residual voltage transformers) selectable between the followings:

100 - 110 - 125

D3 - PRIMARY LINE VOLTAGE (programmable)

V prim

xxxxxxx V

Primary voltage value of the installed line VT's; the value is programmable from 000001 to 999999 V.

In case of direct insertion (without VT's), we suggest to set as primary voltage the same value used as nominal voltage (ref. D1).

Note: The value of the primary line voltage is only used to display the thresholds / measurements in engineering units, and has no influence on the protective functions.
D4 - PRIMARY VT's RESIDUAL VOLTAGE (programmable)

Vo prim
xxxxxxxx V

Primary voltage value of the installed residual voltage VT; the value is programmable from 000001 to 999999 V.

D5 - STANDARD DISPLAY SELECTION (programmable)

DISPLAY
eeeeeee

It allows to select the standard displayed information (ref. A1) when no trip condition occurs and no fault condition have been detected by the self-diagnosis module; the available selections are the following:

- NORMALE displays of ANSI code
- UA displays measured voltage UA
- UB displays measured voltage UB
- UC displays measured voltage UC
- Uo displays measured residual voltage Uo
- FREQ displays measured frequency

The voltages can be line-to-line or line-to-neutral depending on VT's or relay insertion.

Voltages are displayed in primary values (the value depends on D3 and D4 set-ups).

Selection examples:

DISPLAY
NORMALE
DISPLAY
UA
DISPLAY
Uo

D6 - DISPLAY CONTRAST LEVEL (programmable)

CONTRAST
LIV x

The display contrast level is programmable from 0 to 9.
The backlighted display is switched off if no push-button is pressed for at least 5 minutes; when one of the front panel push-button is pressed the display is switched on.

5.5 Thresholds and time delays set-up (fig. 2)

5.5.1 Undervoltage and overvoltage thresholds (27-59)
The information and set-ups related to threshold 27.1 in the following points are effective for all the thresholds 27.2, 59.1, 59.2 changing the threshold identifier.

E1 – THRESHOLD ENABLING (programmable)

27.1
ccc
27.1 threshold identification (27.1, 27.2, 59.1, 59.2)

ccc ON - enabled threshold
OFF - disabled threshold (available but not active)

Examples:

<table>
<thead>
<tr>
<th>27.1</th>
<th>59.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

Note: when a threshold is disabled, the remaining views (E2 ÷ E3) will not be accessible

E2 - THRESHOLD LEVEL SET-UP (programmable)

27.1 n.nn Un

n.nn threshold level expressed in terms of relative values of Un

The available settings for the thresholds are listed in Table A

Examples:

<table>
<thead>
<tr>
<th>27.1</th>
<th>59.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50</td>
<td>1.30</td>
</tr>
</tbody>
</table>

E3 - THRESHOLD LEVEL IN PRIMARY VALUES (not programmable)

27.1 xxxxxx V

The programmed threshold (ref. E2) is shown in terms of primary voltage; the value depends on the programmed VT’s primary values (ref. D3 – paragraph 5.4)

xxxxxx threshold level expressed in Volt (primary values)

E4 - TIME DELAY SET-UP (programmable)

TI 27.1 xx.xx s

Set-up of time-delay to the activation (TRIP) of the programmed output relays when the measured voltage exceeds the threshold level.

xx.xx time delay to activate the programmed output relays, in seconds, from 00.05 to 99.99

5.5.2 Earth fault overvoltage threshold (59N)

E1N - THRESHOLD ENABLING (programmable)

59N.1 ccc
ON - enabled threshold
OFF - disabled threshold (available but not active)

Examples:

<table>
<thead>
<tr>
<th>59N.1</th>
<th>59N.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

Note: when the threshold is disabled, the remaining views (E2N + E5N) will not be accessible

**E2N - THRESHOLD LEVEL SET-UP (programmable)**

| 59N.1 |
| n.nn |

n.nn threshold level expressed in terms of relative values of Uon

The available settings for the threshold are listed in Table A

Examples:

| 59N.1 |
| 0.05 |

**E3N - THRESHOLD LEVEL IN PRIMARY VALUES (not programmable)**

| 59N.1 |
| xxxxx |

The programmed threshold (ref. E2N) is shown in terms of primary voltage; the value depends on the programmed VT’s primary values (ref. D4 – paragraph 5.4)

xxx xxxxx threshold level expressed in Volt (primary values)

**E4N - TIME DELAY SET-UP (programmable)**

| TI 59N.1 |
| xx.xx |

Set-up of time-delay to the activation (TRIP) of the programmed output relays when the measured earth voltage exceeds the threshold level.

xx.xx time delay to activate the programmed output relays, in seconds, from 00.05 to 99.99

**E5N – RELEASE TIME DELAY SET-UP (programmable)**

| TR 59N.1 |
| xx.xx |

Set-up of release time-delay of threshold start condition.

xx.xx release time delay, in seconds from 00.00 to 99.99
5.5.3 Under frequency and over frequency thresholds (81)

The information and set-ups related to threshold 81> in the following points are effective for all the thresholds 81>>, 81< and 81<<, changing the threshold identifier.

**E1F - THRESHOLD ENABLING (programmable)**

<table>
<thead>
<tr>
<th>81&gt;</th>
<th>threshold identifier (81&gt;, 81&gt;&gt;, 81&lt; or 81&lt;&lt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ccc</td>
<td>ON - enabled threshold</td>
</tr>
<tr>
<td></td>
<td>OFF - disabled threshold (available but not active)</td>
</tr>
</tbody>
</table>

Note: when a threshold is disabled, the remaining views (E2F ÷ E3F) will not be accessible

**E2F - THRESHOLD LEVEL SET-UP (programmable)**

<table>
<thead>
<tr>
<th>81&gt;</th>
<th>nn.nn Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>threshold level, in Hertz</td>
</tr>
</tbody>
</table>

The available settings for the thresholds are listed in Table A

Examples:

<table>
<thead>
<tr>
<th>81&gt;</th>
<th>50.50 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>81&lt;</td>
<td>49.30 Hz</td>
</tr>
</tbody>
</table>

**E3F - TIME DELAY SET-UP (programmable)**

<table>
<thead>
<tr>
<th>TI 81&gt;</th>
<th>xx.xx s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>time delay to activate the programmed output relays, in seconds, from 00.05 to 99.99</td>
</tr>
</tbody>
</table>

5.5.4 Frequency thresholds with voltmetric control function (81V)

**E1V - FUNCTION ENABLING (programmable)**

<table>
<thead>
<tr>
<th>FUNZIONE 81V ccc</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON - enabled function</td>
</tr>
<tr>
<td>OFF - disabled function (available but not active)</td>
</tr>
</tbody>
</table>
Note: when the function is disabled, the remaining views (E2V + E10V) will not be accessible

**E2V – THRESHOLD 59Vo ENABLING (programmable)**

<table>
<thead>
<tr>
<th>ABL 59Vo</th>
</tr>
</thead>
<tbody>
<tr>
<td>kkkkkkkk</td>
</tr>
</tbody>
</table>

**OFF** – threshold not enabled in function 81V
**START** – enabled on start condition of threshold 59N.1
**TRIP** – enabled on trip condition of threshold 59N.1

Note: the threshold setup level of the voltmetirc control threshold 59Vo is the same of the threshold 59N.1 (item E2N)

**E3V – THRESHOLD 27V1 ENABLING (programmable)**

<table>
<thead>
<tr>
<th>ABL 27V1</th>
</tr>
</thead>
<tbody>
<tr>
<td>kkkkkkkk</td>
</tr>
</tbody>
</table>

**OFF** – threshold not enabled in function 81V
**START** – enabled on start condition of threshold 27V1
**TRIP** – enabled on trip condition of threshold 27V1

Note: when this threshold is disabled, the remaining views (E4V, E5V) will not be accessible

**E4V - THRESHOLD LEVEL SET-UP (programmable)**

| 27V1 |
| n.nn Un |

**n.nn** threshold level expressed in terms of relative values of Un

The available settings for the threshold are listed in Table A

Example:

| 27V1 |
| 0.70 Un |

**E5V - TIME DELAY SET-UP (programmable)**

| TI 27V1 |
| xx.xx s |

Set-up of time-delay to the activation (TRIP) of the programmed output relays when the measured voltage exceeds the threshold level.

**xx.xx** time delay to activate the programmed output relays, in seconds, from 00.05 to 99.99

Note: this view is accessible only if you have selected TRIP condition in the view E3V.
E6V – THRESHOLD 59V2 ENABLING (programmable)

| ABL 59V2 | kkkkkkk |

- OFF – threshold not enabled in function 81V
- START – enabled on start condition of threshold 59V2
- TRIP – enabled on trip condition of threshold 59V2

Note: when this threshold is disabled, the remaining views (E7V, E8V) will not be accessible.

E7V - THRESHOLD LEVEL SET-UP (programmable)

| 59V2     | n.nn Un |

n.nn threshold level expressed in terms of relative values of Un

The available settings for the threshold are listed in Table A.

Example:

| 59V2     | 0.20 Un |

E8V - TIME DELAY SET-UP (programmable)

| TI 59V2  | xx.xx s |

Set-up of time-delay to the activation (TRIP) of the programmed output relays when the measured voltage exceeds the threshold level.

xx.xx time delay to activate the programmed output relays, in seconds, from 00.05 to 99.99

Note: this view is accessible only if you have selected TRIP condition in the view E6V.

E9V – LOCAL COMMAND SIGNAL STATUS (not programmable)

| COM LOC  | yyyy    |

- BASSO – Local Command signal is at logical status LOW
- ALTO – Local Command signal is at logical status HIGH
- NON PRES – no digital input programmed for COM LOC function

This indicator shows the current logic state of the digital input set as COM LOC (Local Command).
E10V - RELAISE TIME DELAY SET-UP (programmable)

| TR 81V | xxx.x s |

xxx.x  
function release time delay, in seconds, from 0.0 to 999.9

Example:

| TR 81V | 180.0 s |

5.5.5 Breaker Failure Function (MAI)

E1M - FUNCTION ENABLING (programmable)

| MAI | ccc |

ccc  
ON - enabled function
OFF - disabled function (available but not active)

E2M - TIME DELAY FUNCTION SET-UP (programmable)

| TI MAI | xx.xx s |

xx.xx  
delay time for detecting open status of circuit breaker, in seconds, from 00.05 to 99.99

Example:

| TI MAI | 00.20 s |

E3M – ADDITIONAL INFORMATION (not programmable)

| MAI | zz |

zz  
This view shows information on digital inputs related to this function.

The parameter zz could have one of the following values:

- AP  
digital input get the open status of the circuit breaker
- CH  
digital input get the close status of the circuit breaker
- --  
no digital input is programmed to get the status of the circuit breaker

The parameter eeeeee could have one of the following values:

- DISABIL  
no digital input is programmed to get the status of the circuit breaker

---

5 The combination of no digital input configured to acquire the status of the circuit breaker and function of MAI enabled, it is signaled as being erroneous condition and it is not possible to store the setup data. You have to correct this by appropriately programming the digital inputs or disabling the MAI function.
DIG1 digital input 1 is programmed to acquire the circuit breaker status
DIG2 digital input 2 is programmed to acquire the circuit breaker status
DIG3 digital input 3 is programmed to acquire the circuit breaker status

Only one digital input could be programmed to acquire the circuit breaker status.

Example:

```
MAI   AP
DIG1
```

This allows to the DIA4N protection relay to command a further circuit breaker in case that the main circuit breaker does not open.

Note: In connection schematics at par. 6 it is shown a possible solution for the realization of the Breaker Failure function. The setup values related to digital inputs and output relays for such solution are listed in Table B and C.

5.6 Output relays programming (fig. 3)

The session allows to program the activation of the output relays R1, R2, R3 or R4 on START or TRIP conditions for each threshold.

Equivalent information and set-up related to relay R1 is available for the relays R2, R3 and R4 just changing the relay identification.

**F1 - OUTPUT RELAY R1 QUIESCENT STATUS (programmable)**

```
R1
NORM xxx
```

Programming of the R1 relay status when no START or TRIP conditions are activated (none of the measured voltages exceed their thresholds).

- NORM OFF: normally de-energized (energized status on activation)
- NORM ON: normally energized (de-energized status on activation)

Note: As default setting the output relay R1 is programmed as normally energized and it collects the TRIP conditions of the various protection functions; in such way that output relay can be used to control the interface circuit breaker, which, according to the norm CEI 0-16 ed. 3, must be equipped with an undervoltage coil.

**F2 - OUTPUT RELAY R1 ACTIVATION ON THRESHOLD 27.1 STATUS (programmable)**

```
R1  27.1
xxxxxx
```

Programming of the R1 output relay activation (START / TRIP / NO AZION) for threshold 27.1.

The parameter xxxxx is selectable as the following:
START instantaneous output relay R1 activation when one of the measured line voltage is below the programmed threshold 27.1
TRIP output relay R1 activation when one of the measured line voltage is below the programmed threshold level 27.1 for at least TI seconds
NO AZION no activation related to threshold 27.1

F3 ÷ F15 - OUTPUT RELAY ACTIVATION ON THRESHOLDS 27.2, 59.1, 59.2, 59N.1, 81>, 81>>, 81<, 81<<, 81V, MAI, EXT (programmable)

Examples:

\[
\begin{array}{ccc}
R1 & 27.2 & R1 \ 59.2 \\
\text{x x x x x x} & \text{x x x x x x} & \text{x x x x x x}
\end{array}
\]

Programming of the R1 output relay activation (START, TRIP or NO AZION) on thresholds 27.2, 59.1, 59.2, 59N.1, 81>, 81>>, 81<, 81<<, 81V, 27V1, 59V2, MAI, EXT (the same as threshold 27.1 - rif. F2).

Notes:
1. For MAI and EXT functions it is only possible to program the items TRIP or NO AZION.
2. For 81V function it is only possible to program the items START or NO AZION.
3. If the function 81V is disabled, the settings related to functions 81V, 27V1 and 59V2 will not be available.
4. If the function MAI is disabled, the settings related to function MAI will not be available.

The output relay settings on thresholds 27V1 and 59V2 are usually used only during commissioning.

F16 - TEST OF OUTPUT RELAY R1

See paragraph 4.4

5.7 Digital inputs function programming (fig. 3)

For each digital input one of the following functions are selectable:

a) disable of one threshold, or for a threshold group or for all thresholds;
b) STATUS function (recording of measures on external command) (paragraph 1)
c) pilot wire fault monitoring (only DIG2 monitors DIG1) (paragraph 1)
d) remote trip command (TRIP EXT)
e) circuit breaker status
f) Local Command signal status
When the function of more than one digital input refers to the same threshold, the priority will be the following:

a) the OF TUTTI selection (ALL the thresholds) has the priority on single threshold selection

**G1 - DIGITAL INPUT DIG1 SET-UP (programmable)**

Programming of the function related to digital input channel 1 (DIG1).

**Parameter cc**: programming of the condition that activates the function related to digital input DIG1; the condition is selectable between HI and LO.

**Parameter xxxxxxxx**: programming of the function related to digital input DIG1; to scroll the list use the key [▲]. The following functions are selectable:

- **ESCLUSO**: no functions active related to digital input DIG1
- **OF 27**: thresholds 27.1 and 27.2 disabled
- **OF 27.1**: threshold 27.1 disabled
- **OF 27.2**: threshold 27.2 disabled
- **OF 59**: thresholds 59.1 and 59.2 disabled
- **OF 59.1**: threshold 59.1 disabled
- **OF 59.2**: threshold 59.2 disabled
- **OF 59N.1**: threshold 59N.1 disabled
- **OF 81**: thresholds 81>, 81>>, 81< and 81<< disabled
- **OF 81>**: threshold 81> disabled
- **OF 81>>**: threshold 81>> disabled
- **OF 81<**: threshold 81< disabled
- **OF 81<<**: threshold 81<< disabled
- **OF MAI**: MAI function disabled
- **OF TUTTI**: all thresholds disabled
- **COM LOC**: get the Local Command status signal
- **TRIP EXT**: get the Remote Trip signal
- **52 AP**: get the circuit breaker OPEN status signal
- **52 CH**: get the circuit breaker CLOSE status signal
- **STATO**: activation of status function (see paragraph 1)

**G2 - DIGITAL INPUT DIG2 SET-UP (programmable)**

Programming of the function related to digital input channel 2 (DIG2); the selections available are the same as presented for DIG1 (ref. G1) plus the following:

**MONITOR**: activation of pilot wire monitor function.
G3 - DIGITAL INPUT DIG3 SET-UP (programmable)

Programming of the function related to digital input channel 3 (DIG3); the selections available are the same as presented for DIG1 (ref. G1).

5.8 Special functions programming (fig. 3)

5.8.1 Remote trip

Allows you to configure the parameters related to the function of remote trip (trip on external signal).

H1 - TRIP EXT DELAY (programmable)

Programming the delay for the operation of the output relay associated to the remote trip external signal (TRIP EXT, par. 5.6 – rif. F15 and par. 5.7).

H2 – ADDITIONAL INFORMATIONS (not programmable)

It shows information on digital inputs related to this function.

The setting yyyy yyyy is one in the following values:

- DISABIL no digital input is programmed to acquire the remote trip signal. The function is disabled
- DIG1 digital input 1 acquires the remote trip signal
- DIG2 digital input 2 acquires the remote trip signal
- DIG3 digital input 3 acquires the remote trip signal

It is possible to program two or more digital inputs to acquire the remote trip signals (es. DIG 1,3). In such case an OR logical is used to get the resulting signal.

5.9 Parameter values visualization (fig. 3)

L1 ÷ L12 - THRESHOLDS STATUS

The actual status of each threshold is displayed.

For each threshold are displayed the threshold identification (27.1, 59.1, etc.) and the threshold status; the status can show one of the following values:

- ON active threshold
- OFF disabled threshold (programmed OFF at ref E1, E1N, E1F - par. 5.5)
- OFF_DIG threshold programmed active but momentary disabled by a digital input actual status (ref. G1, G2, G3 - par. 5.7)
OFF_TEMP threshold programmed active but momentary disabled for the absence of conditions for enabling of the threshold one₆.

Examples:

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>27.1</td>
<td>59.2</td>
<td>59N.1</td>
<td>81&gt;</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF TEMP</td>
</tr>
</tbody>
</table>

**M1 - M2 - OUTPUT RELAY STATUS**

The actual status of each output relay is displayed; for each relay the following information is displayed:

- relay identification (R1, R2, R3, R4)
- relay status (ON - activated, OFF - non activated)

Note that ON/OFF do not necessary mean energized or de-energized (see ref. F1).

**N1 - N2 - DIGITAL INPUT STATUS**

The actual status of each digital input is displayed.

For each digital input the following information is presented:

- digital input identification (DIG1, DIG2, DIG3)
- digital input status (HI or LO)

**P1 ÷ P10 - DISPLAY OF MEASUREMENTS**

The actual value of the measured voltages and frequency is displayed.

It displays in succession the current status of the measurements of line voltages, the residual voltage, frequency, positive voltage sequence, negative voltage sequence and line voltages averaged over 10 minutes.

In each view it is shown the identifier of the measurement and the measurement unit.

Examples:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UA= 1.20</td>
<td>UC= 0.86</td>
<td>FREQ</td>
</tr>
<tr>
<td>24000 V</td>
<td>8600 V</td>
<td>50.00 Hz</td>
</tr>
</tbody>
</table>

When an electrical quantity is not measurable it is presented with "*" (asterisks); this may occur for example when the amplitude of the voltage UA is below the minimum threshold for a reliable measurement of the frequency.

If the frequency is outside the measurement range of protection relay, a special indication is presented, depending if the frequency measurement is too low or too high.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FREQ &lt; 35 Hz</td>
<td>FREQ &gt; 75 Hz</td>
</tr>
</tbody>
</table>

₆ This condition may occur for the function 81V and thresholds 81> and 81<.
5.10 Events (fig. 4)

On the display are shown the memorized information related to the last 8 TRIP events of thresholds or for the STATO function (ref. par. 1).

The 8 events are recorded and identified with a progressive number from 1 to 8; the more recent event shows a lower number.

Note: through the event recording function, you can retrieve information about the last threshold trip also if there has been a subsequent absence of the auxiliary voltage. In such case there would be the disappearance of the signals stored by the LEDs and the display.

Q1 - EVENT NUMBER

E1
cccccccc

The index E1, E2 ... E8 identifies the memorized event.

The parameter cccccc gives information on the kind of event and it can show one of the following values:

- NESSUNO: no event memorized
- 27.1: event on threshold 27.1 trip
- 27.2: event on threshold 27.2 trip
- 59.1: event on threshold 59.1 trip
- 59.2: event on threshold 59.2 trip
- 59N.1: event on threshold 59N.1 trip
- 81>: event on threshold 81> trip
- 81>>: event on threshold 81>> trip
- 81<: event on threshold 81< trip
- 81<<: event on threshold 81<< trip
- EXT: event caused by function TRIP EXT
- MAI: event caused by function MAI
- STATO: information recorded on external command (function STATO ref. par. 1)
- POWER ON: switch-on of the protection relay (auxiliary power)

For the event NESSUNO no other information is presented.

For the event POWER ON, the date and time of the switch-on of the protection relay are presented.

For the other events the following displays give more detailed information on the event.

Q2 - TRIP THRESHOLD (TRIP)

E1
sss
xx.xx

The information is not shown on STATO, MAI and TRIP EXT events
It shows the threshold related to the TRIP condition of the protection relay and the value of the threshold (in relative terms).

- **ssss**: threshold identifier (i.e.: 27.1, 59.2, 81>, etc.)
- **xx.xx**: threshold value

**Examples:**

<table>
<thead>
<tr>
<th>E4</th>
<th>27.1</th>
<th>E2</th>
<th>81&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50 Un</td>
<td>51.00 Hz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Q3 - ACTIVATED OUTPUT RELAYS**

The information is not shown on STATO events

It shows the list of the output relays activated by the threshold trip.

**Examples:**

<table>
<thead>
<tr>
<th>E1</th>
<th>RELE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,3,4</td>
<td></td>
</tr>
</tbody>
</table>

When no output relays have been activated (no relays programmed to TRIP on the threshold) the following message will be displayed:

<table>
<thead>
<tr>
<th>E1</th>
<th>RELE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NESSUNO</td>
<td></td>
</tr>
</tbody>
</table>

**Q4 - TOTAL TIME DELAY TO TRIP**

It is shown the total delay to the TRIP of the output relays related to the threshold. If the total time is greater than 999 seconds the display of tenths is omitted.

When the event is memorized on external command (STATO), the message N/A (Not Applicable) is shown instead of the number of seconds.

<table>
<thead>
<tr>
<th>E1 T-Tot</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
</tr>
</tbody>
</table>

**Q5 - DIGITAL CHANNELS RELATED TO MEMORIZED EVENT**

The list of the digital inputs related to the memorized event is displayed (function STATO - ref. E4 - par. 5.7).

If no digital inputs were activated, the message NESSUNO is shown.
Q6 - Q7 - Q8 - Q9 - Q10 - MEMORIZED MEASURED VOLTAGES AND FREQUENCY ON EVENT

<table>
<thead>
<tr>
<th>E1 UA</th>
<th>y.yy Un</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1 UB</td>
<td>y.yy Un</td>
</tr>
<tr>
<td>E1 UC</td>
<td>y.yy Un</td>
</tr>
<tr>
<td>E1 Uo</td>
<td>y.yy Un</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>E1 FREQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>yy.yy Hz</td>
</tr>
</tbody>
</table>

The values of the measured voltages and frequency at the event are displayed; for the voltages the values are expressed as Un and Uon terms, the frequency is in Hertz.

Q11 - Q12 - Q13 - DIGITAL INPUTS STATUS ON EVENT

| E1 DIG1 vv |
| E1 DIG2 vv |
| E1 DIG3 vv |

The status of the digital inputs at the event are displayed.

The parameter vv can assume the value HI or LO.

Q14 - Q15 - DATE AND TIME OF THE EVENT

<table>
<thead>
<tr>
<th>E1 Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>gg/mm/aa</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>E1 Ora</th>
</tr>
</thead>
<tbody>
<tr>
<td>hh:mm:ss</td>
</tr>
</tbody>
</table>

The date and time of the event are showed.

5.11 Trip counters (fig. 4)

In this section are displayed the total and partial counters of the output relay activation (on TRIP conditions) for each thresholds and the numbers of programming sessions with the date and time of the last confirmed programming session.

The total counters, the number of confirmed programming sessions and the date and time of the last confirmed programming session are not modifiable or resettable; the information related to the last programming session are used to control unauthorized access.

The partial counter can be modified following the standard set-up procedure for parameters as described at paragraph 4.2; the partial counters are immediately modified in the memory (the recorded values are immediately resetted without the need of the programming confirmation).

R1 ÷ R22 - TRIP COUNTERS

| 27.1 P cccc |
| 27.1 T cccc |

Display of the partial (P) and total (T) counters of the TRIP condition related to each threshold.

When the value exceed 9999 the counter starts again from 0000.
The counters are identified by the threshold name (27.1, 27.2, 59.1, 59.2, 59N.1, etc.).

The partial counters are modifiable in the range from 0000 to 9999 following the standard set-up procedure (paragraph 4.2).

**R23 ÷ R25 - TOTAL PROGRAMMING SESSIONS AND DATE/TIME OF THE LAST PROGRAMMING SESSION**

<table>
<thead>
<tr>
<th>TOT PRG</th>
<th>DATA PRG</th>
<th>ORA PRG</th>
</tr>
</thead>
<tbody>
<tr>
<td>eeee</td>
<td>gg/mm/aa</td>
<td>hh:mm:ss</td>
</tr>
</tbody>
</table>

Display of the number of confirmed programming sessions (from the factory set-up) and the date and time of the last confirmed programming session.
6 INSTALLATION

6.1 Supplied kit

RK VERSION - 19” rack installation (the proper rack is supplied by SEB)

- protection relay module DIA4N with rear socket
- transparent front panel for rack installation
- blister with items 1-2-3-4-5

CS VERSION - flush mounting installation

- protection relay module DIA4N with rear socket
- transparent front panel for rack flush mounting installation
- n° 2 brackets for flush mounting
- blister with items 1-2-3-4-5
- blister with item 6

1) n° 8 screws to fix wire terminals of current circuits (NOT USED)
2) n° 4 screws to fix the relay rear socket on the 19" rack (or on the two brackets for flush mounting) and n° 2 screws to fix (optionally) the protection relay on the front of the 19" rack
3) n° 2 knobs to fix the transparent front panel
4) n° 8 washers to be used to fix wire current terminals (NOT USED)
5) n° 8 growers to be used to fix wire current terminals (NOT USED)
6) small items to fix brackets on the cabinet (only CS version)

The knobs to fix the transparent front panel must be screwed through the front panel itself; the operation will create a screw thread in the plastic material to prevent knob missing.
NOTE The items related to current inputs are the standard supplied items with all SIGMA N protection relays but for the DIA4N model they are not used.

6.2 Cabling

Voltage circuits

It is suggested to terminate the voltage wirings using plug terminals.

Minimum suggested wire cross section: 1,5 mm²

With reference to the insertion diagram in the next page, the voltages measured by the protection relay have the following matching:

<table>
<thead>
<tr>
<th>Circuit</th>
<th>Terminals</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UA</td>
<td>1 – 3</td>
<td>voltages with Un programmed greater than 125 V to 400 V</td>
</tr>
<tr>
<td></td>
<td>2 – 3</td>
<td>voltages with Un programmed from 0 to 125 V</td>
</tr>
<tr>
<td>UB</td>
<td>6 – 8</td>
<td>voltages with Un programmed greater than 125 V to 400 V</td>
</tr>
<tr>
<td></td>
<td>7 – 8</td>
<td>voltages with Un programmed from 0 to 125 V</td>
</tr>
<tr>
<td>UC</td>
<td>11 – 13</td>
<td>voltages with Un programmed greater than 125 V to 400 V</td>
</tr>
<tr>
<td></td>
<td>12 – 13</td>
<td>voltages with Un programmed from 0 to 125 V</td>
</tr>
<tr>
<td>Uo</td>
<td>17 - 18</td>
<td>voltages with Uon programmed from 0 to 125 V</td>
</tr>
</tbody>
</table>

The input terminals related to Uo have to be connected to a VT sensible to residual voltages (e.g. star-open delta VT module).

Other circuits (output relays etc.)

It is suggested to terminate the wiring using plug terminals.

Minimum suggested wire cross section: 1,5 mm²

IMPORTANT

In case of use of the protection relay in plants compliant to the requirements of the norm CEI 0-16 ed. 3, due to the presence of the positive sequence undervoltage and negative sequence overvoltage thresholds, it is absolutely necessary to respect the phase rotation sequence in the connection of the plant and the DIA4N protection relay.

In the case of plants built according to wiring diagrams found in previous versions of the manual, used with DIA4N equipped with firmware versions prior to 3.4, in which the phase rotation sequence was not important, please check the connections of the line voltages, to ensure the correct phase rotation sequence.

Please refer to the wiring diagrams on the following pages.

To verify the correct phase rotation sequence you must enabled: the function 81V, the thresholds 27.1 and 59.2. In this way, you can measure the positive sequence voltage
(U1) and negative sequence voltage (U2) in the appropriate section of the menu (see P6 and P7, par. 5.9).

In conditions of absence of a fault in the network, you must have a positive sequence voltage (U1) almost equal to that of the line voltages and a negative sequence voltage (U2) close to 0.

If the previous tests are failed, please check the wiring between the line voltage and the input voltages of the DIA4N protection relay.

The following figure shows the connection for the measurement of residual voltage, obtained by using the 3 TVs connected phase-to-ground in MV.

Residual voltage measurement (Uo) in MV using 3 TVs

In the following wiring diagrams in which it is represented the Interface Device (DI), it is assumed that it is equipped with undervoltage coil (as required by the norm CEI 0-16).
Phase to phase insertion in MV with 3 TVs (Un secondary ≤ 125 V)
Phase to phase insertion in MV with 2 TVs (Un sec. ≤ 125 V) – With MAI function
Recommended solution for MV connection according to norm CEI 0-16
Phase to ground insertion in MV with 3 TVs (Un secondary ≤ 125 V)
Useful only for plants which are not compliant to norm CEI 0-16
Phase to phase insertion in LV (Un > 125 V) – With MAI function
Recommended solution for LV connection according to norm CEI 0-16
Phase to neutral insertion in LV (Un > 125 V) – With MAI function (optional)
Useful only for plants which are not compliant to norm CEI 0-16
Dimensioni meccaniche
Case outlines

Dima montaggio da incasso
Flush mounting panel cut-out

Montaggio incassato / Flush mounting
Dimensioni pannello frontale trasparente:
Transparent front panel sizes:
208 x 89,5 mm.
6.3 Relays R3 and R4 - Signaling / Command set-up

The protection relay is supplied with R3 and R4 relays configured as **SIGNALING RELAYS**, with 2 change-over output contacts with breaking capability equals to 0.2 A at 110 Vdc, L/R = 40 ms, 100000 operations.

Each R3 and R4 relay can be configured as **COMMAND RELAY** with 1 change-over output contact with breaking capability equals to 0.5 A at 110 Vdc, L/R = 40 ms, 100000 operations.

The new configuration is obtained with the following cabling:

![Cabling Diagram]

6.4 RS485 serial communication port

The digital protection relay DIA4N has an insulated serial interface RS485 half-duplex that allow the multi-drop connection up to 31 protection units.

When the **STANDARD Seb communication protocol** is selected, the transmission speed is automatically selected between 300 to 9600 bauds and the protocol is ASCII-HEX; the documentation related to the protocol is freely available on request.

When the **MODBUS communication protocol** is selected, the transmission speed can be programmed between 300 to 9600 bauds (ref. B3, par 5.3); the protocol is in ASCII mode and runs as SLAVE functional mode.

It is suggested to use a shielded twisted pair AWG22; terminal 19 (not connected internally) can be used for shields connections.
It is suggested to terminate the serial line with a resistance $120 \, \Omega$, 1/4 W.
7 TECHNICAL CHARACTERISTICS

Measuring inputs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated line voltage (Un)</td>
<td>programmable</td>
</tr>
<tr>
<td></td>
<td>57.73 - 63.50 - 72.16 - 100 - 110 V</td>
</tr>
<tr>
<td></td>
<td>125 - 190 - 220 - 230 - 380 - 400 V</td>
</tr>
<tr>
<td></td>
<td>200 - 202 - 208 - 240 - 270 - 277 V</td>
</tr>
<tr>
<td></td>
<td>300 - 315 - 320 V</td>
</tr>
<tr>
<td>Rated residual voltage (Uon)</td>
<td>programmable</td>
</tr>
<tr>
<td></td>
<td>100 - 110 - 125 V</td>
</tr>
<tr>
<td>Thermal withstand continuously</td>
<td>2 Un - Uon</td>
</tr>
<tr>
<td>Thermal withstand for 1 s</td>
<td>2 Un - Uon</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Primary VT’s voltage</td>
<td>1 - 999999 V</td>
</tr>
<tr>
<td>Burden at rated voltage</td>
<td>0.5 VA / phase</td>
</tr>
<tr>
<td>Frequency measurement range</td>
<td>35 ÷ 75 Hz</td>
</tr>
</tbody>
</table>

Output contacts ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of relays (note 1)</td>
<td>4 + 1</td>
</tr>
<tr>
<td>Rated current</td>
<td>5 A</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>250 V</td>
</tr>
<tr>
<td>Contact configuration</td>
<td>change over</td>
</tr>
<tr>
<td>Breaking capability (note 2)</td>
<td></td>
</tr>
<tr>
<td>- tripping relays (R1, R2)</td>
<td>0.5 A</td>
</tr>
<tr>
<td>- signaling relays (R3, R4, R5) (note 3)</td>
<td>0.2 A</td>
</tr>
<tr>
<td>Mechanical life</td>
<td>&gt; 10⁶</td>
</tr>
</tbody>
</table>

Digital inputs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of inputs</td>
<td>3</td>
</tr>
<tr>
<td>External control voltage</td>
<td>as Uaux</td>
</tr>
<tr>
<td>Typical current (sink)</td>
<td>2 mA</td>
</tr>
</tbody>
</table>

Data transmission

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>RS485 half duplex</td>
</tr>
<tr>
<td>Communication protocol</td>
<td>MOD-BUS ASCII</td>
</tr>
<tr>
<td>Transmission speed</td>
<td>300 - 9600 baud selectable</td>
</tr>
<tr>
<td>Optional</td>
<td>optical fiber module</td>
</tr>
</tbody>
</table>

Auxiliary supply

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>24 ÷ 320 Vdc ± 20%</td>
</tr>
<tr>
<td>Frequency (Vac)</td>
<td>48 ÷ 230 Vac ± 20%</td>
</tr>
<tr>
<td>Burdens (min/max)</td>
<td>47 ÷ 63 Hz</td>
</tr>
<tr>
<td></td>
<td>5 / 10 W</td>
</tr>
</tbody>
</table>

Environmental conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation</td>
<td>- 10 / +60 °C</td>
</tr>
<tr>
<td>Transport and storage</td>
<td>- 25 / +80 °C</td>
</tr>
<tr>
<td>Relative humidity (without condensation)</td>
<td>&lt; 95%</td>
</tr>
<tr>
<td>Protection degree for flush mounting (optional)</td>
<td>IP 52 (IP 54)</td>
</tr>
<tr>
<td>Weight</td>
<td>2.5 kg</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Note 1) The additional relay R5 is controlled by self-test program</td>
<td></td>
</tr>
<tr>
<td>Note 2) Breaking capability at 110 Vdc, L/R 40 ms, 100,000 operations</td>
<td></td>
</tr>
<tr>
<td>Note 3) The output contacts of R3 and R4 relays can be configured as signaling or tripping relays</td>
<td></td>
</tr>
</tbody>
</table>
## 8 TABLES

### Table A Rated values and settings

<table>
<thead>
<tr>
<th>ANSI</th>
<th>THRESHOLDS</th>
<th>Settings</th>
<th>Resolution</th>
<th>Dropout ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>Undervoltage (27.1, 27.2)</td>
<td>$0.05 \div 1.00 \text{ Un}$</td>
<td>$0.01 \text{ Un}$</td>
<td>$\leq 1.05$</td>
</tr>
<tr>
<td>59</td>
<td>Overvoltage (59.1, 59.2)</td>
<td>$0.50 \div 1.50 \text{ Un}$</td>
<td>$0.01 \text{ Un}$</td>
<td>$\geq 0.95$</td>
</tr>
<tr>
<td>59N</td>
<td>Residual earth fault (59N.1)</td>
<td>$0.02 \div 1.00 \text{ Uon}$</td>
<td>$0.01 \text{ Uon}$</td>
<td>$\geq 0.95$</td>
</tr>
<tr>
<td>81</td>
<td>Over frequency (81&gt;, 81&gt;&gt;)</td>
<td>$50.00 \div 55.00 \text{ Hz}$</td>
<td>$0.01 \text{ Hz}$</td>
<td>$\geq 0.998$</td>
</tr>
<tr>
<td></td>
<td>Under frequency (81&lt;, 81&lt;&lt;)</td>
<td>$45.00 \div 50.00 \text{ Hz}$</td>
<td>$0.01 \text{ Hz}$</td>
<td>$\leq 1.002$</td>
</tr>
<tr>
<td>27V1</td>
<td>Positive sequence undervoltage (27V1)</td>
<td>$0.05 \div 1.00 \text{ Un}$</td>
<td>$0.01 \text{ Un}$</td>
<td>$\leq 1.05$</td>
</tr>
<tr>
<td>59V2</td>
<td>Negative sequence overvoltage (59V2)</td>
<td>$0.05 \div 1.50 \text{ Un}$</td>
<td>$0.01 \text{ Un}$</td>
<td>$\geq 0.95$</td>
</tr>
</tbody>
</table>

### Timers

<table>
<thead>
<tr>
<th></th>
<th>Settings</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay time</td>
<td>All thresholds</td>
<td>$0.05 \div 99.99 \text{ s}$</td>
</tr>
<tr>
<td>TR 59N.1</td>
<td>$0.00 \div 99.99 \text{ s}$</td>
<td>$0.01 \text{ s}$</td>
</tr>
<tr>
<td>TR 81V</td>
<td>$0.0 \div 999.9 \text{ s}$</td>
<td>$0.1 \text{ s}$</td>
</tr>
<tr>
<td>Remote Trip</td>
<td>$0.00 \div 99.99 \text{ s}$</td>
<td>$0.01 \text{ s}$</td>
</tr>
</tbody>
</table>
Table B: Configuration for operation in accordance with CEI 0-16 ed. 3

This table shows an example of configuration for DIA4N protection relay for using in plants compliant to norm CEI 0-16. The values shown as "typical" in Table B correspond to the default configuration of the protection; these values are preset with the aim of allowing an easier configuration of the setting parameters in the process of commissioning of the protection relay, by minimizing, to the extent possible, the number of parameters to be changed by the user.

Verification of the configuration parameters to the characteristics of the plant and to the calibration values required by the energy distributor is under the responsibility to the user of protection.

The settings for the MAI function are referred to connections according to the previous wiring diagram.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Un</td>
<td>According to plant characteristics</td>
</tr>
<tr>
<td>Uon</td>
<td>According to plant characteristics (typical 100 V)</td>
</tr>
<tr>
<td>Up</td>
<td>According to plant characteristics</td>
</tr>
<tr>
<td>Uop</td>
<td>According to plant characteristics</td>
</tr>
<tr>
<td>27.1</td>
<td>ON</td>
</tr>
<tr>
<td>TI 27.1</td>
<td>According to energy distributor requirements (typical 0.85 Un)</td>
</tr>
<tr>
<td>27.2</td>
<td>ON</td>
</tr>
<tr>
<td>TI 27.2</td>
<td>According to energy distributor requirements (typical 0.40 Un)</td>
</tr>
<tr>
<td>59.1</td>
<td>ON</td>
</tr>
<tr>
<td>TI 59.1</td>
<td>According to energy distributor requirements (typical 1.10 Un)</td>
</tr>
<tr>
<td>59.2</td>
<td>ON</td>
</tr>
<tr>
<td>TI 59.2</td>
<td>According to energy distributor requirements (typical 1.20 Un)</td>
</tr>
<tr>
<td>59N.1</td>
<td>ON</td>
</tr>
<tr>
<td>TI 59N.1</td>
<td>According to energy distributor requirements (typical 0.05 Uon)</td>
</tr>
<tr>
<td>TR 59N.1</td>
<td>According to energy distributor requirements (typical 0.2 s)</td>
</tr>
<tr>
<td>81&gt;</td>
<td>ON</td>
</tr>
<tr>
<td>TI 81&gt;</td>
<td>According to energy distributor requirements (typical 50.2 Hz)</td>
</tr>
<tr>
<td>81&gt;&gt;</td>
<td>ON</td>
</tr>
<tr>
<td>TI 81&gt;&gt;</td>
<td>According to energy distributor requirements (typical 51.5 Hz)</td>
</tr>
<tr>
<td>81&lt;</td>
<td>ON</td>
</tr>
<tr>
<td>TI 81&lt;</td>
<td>According to energy distributor requirements (typical 49.8 Hz)</td>
</tr>
<tr>
<td>81&lt;&lt;</td>
<td>ON</td>
</tr>
<tr>
<td>TI 81&lt;&lt;</td>
<td>According to energy distributor requirements (typical 47.5 Hz)</td>
</tr>
</tbody>
</table>
TI 81<< According to energy distributor requirements (typical 4.0 s)

81V  
ABL 59V0  START
ABL 27V1  START
27V1 According to energy distributor requirements (typical 0.7 Un)
ABL 59V2  START
59V2 According to energy distributor requirements (typical 0.15 Un)
COM LOC  According to energy distributor requirements
TR 81V  According to energy distributor requirements (typical 30 s)

MAI  0.5 s
MAI (if required by energy distributor) (default OFF)

TEXT 0.00 s

DIG1 active status  → HI  52 AP (Only if MAI function is enabled) (default ESCLUSO)
DIG2 active status  → HI  COM LOC
DIG3 active status  → HI  TRIP EXT

RL1  Norm ON  TRIP 27.1 27.2 59.1 59.2 59N.1 81> 81>> 81< 81<<  
RL2  Norm OFF  TRIP MAI
RL3  Norm OFF  START 81V
RL4  Norm OFF

Other settings not listed in this table are not important for the functionality of the protection relay.

Note: For the proper operation of the protection relay in plant compliant to norm CEI 0-16, it is recommended not to change the configuration of the relay RL1 (used to control the interface circuit breaker) from the default programming.

7 The setting of the Local Command status is supplied by the energy distributor